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Bulletin of the Taylor Society

A Society to Promote the Science of Management

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ANNUAL MEETING

The annual meeting will be held in the Engineering Societies' Building, 29 West 39th St., New York City, Friday and Saturday, December 8 and 9. A summary of the program follows:

Friday, December 8

8.15 P. M. at Engineering Societies' Building.
"Application of Scientific Management to Professional Work in Hospitals and Doctors' Offices".
By Dr. Robert L. Dickinson, Brooklyn, N. Y.

Saturday, December 9

10.00 A. M. at Engineering Societies' Building.
"Planning of Power Plant Work".
By Walter N. Polakov, New York City.

12.30 P. M. Luncheon, Hofbrau House, 34 West 30th St.

2.15 P. M. at Engineering Societies' Building.
"Scientific Management and Progress".
By Horace B. Drury, Ohio State University, Columbus, Ohio. (This paper, previously printed and distributed, will be read by title only.)

6.30 P. M. Dinner, Hofbrau House, 34 West 30th St.

8.15 P. M. at Hofbrau House, 34 West 30th St.
"Discipline on the Border".
By Paul B. Vallé, New Haven, Conn.
"Who Is Boss in Your Shop?"
By Morris L. Cooke, Philadelphia, Pa.

Judging from the nature and variety of the topics to be discussed, this meeting will probably prove one of the largest and most successful regular meetings ever held by the Society.

All of the sessions will, as usual, be open to guests including ladies. Members are cordially requested to invite any friends who would be interested and to see that notification of all who expect to attend is in the hands of the chairman of the local committee, Mr. John H. Williams, 772 Park Avenue, New York City, not later than Wednesday, December 6.

COMMENT AND NEWS

The fall meeting of the Society, held in Philadelphia, October 28th, was the largest such meeting ever held, except of course the special Taylor memorial meeting last year. The paper on "Application of Scientific Management to the Beating of Paper" by Arthur B. Green, S. D. Warren Co., Cumberland Mills, Maine, aroused much interest and discussion. This paper with discussion is given in full elsewhere in this BULLETIN.

The evening session was devoted to a discussion of the affairs of the Society and its spirit and interest will be long remembered by those present. The following special items of interest should be noted:

The joint invitation of the University of Minnesota and of the Minneapolis Civic and Commerce Association to hold a coming conference at the University of Minnesota was accepted. The exact time for this conference was left to the Governing Board with power. While the special invitation named the fall of 1917, other plans already made will prevent our holding a conference in Minneapolis until a later date.

Suggestions to improve the financial condition of the Society included the consideration of sustaining memberships. This idea was approved by the meeting and referred to the Governing Board for action.

The question of affiliating with this Society local Taylor Societies, either in individual plants or made up from various plants in individual cities, was also referred to the Governing Board. The growth of such local societies has been increasing, and it was considered important that some way be found for the Society both to receive and give the stimulation of closer association with local activities in this line. Mr. Shipley spoke of the growth of the local society in New Haven which started with one plant but would soon include all the plants in that city undertaking Scientific Management.

Committee work as a method of further increasing the work of the Society was discussed and the following committees were suggested, although no action was taken at the meeting toward the formation of such committees:

1. Principles and Progress.
   Covering statistics, history, legislation, relation to public welfare and publicity.
2. Stores and Transportation.
3. Routing and Planning.
4. Processes, including machinery, materials, waste products.
5. Labor Problems, including wage systems.
6. Cost-Keeping and Accounting, including records and indexing.
7. Time and Motion Study.

How to make the BULLETIN more useful to members and other subscribers was taken up, and among the suggestions of which the following out now seems possible of fulfillment, were: greater regularity, larger size, the inclusion of notes and reviews from members on current articles of interest, and sometimes the republication of papers and articles of worth which have already appeared elsewhere. It was also planned to devote a part of future meetings to the discussion of the more standardized technique of the Taylor System, for the instruction of new members.

A considerable and very gratifying interest and willingness to coöperate in the presenting of papers was manifest, so that the Secretary's office has now a larger supply of actual and definitely promised material for publication within the coming year than ever before in the history of the Society. Most of this has come in since the October meeting and it is believed that this is only a beginning of an active coöperation on the part of all members of all grades in forwarding the work of the Society. Even at personal sacrifice, those at the meeting and those who have been approached since, have shown a most encouraging spirit of coöperation. One of the plainly dominant ideas in the meeting was the necessity of every member's doing his share. It was even suggested that the presenting of a paper before the Society be made a condition of full membership.

The Society felt honored by the presence of Mrs. Frederick W. Taylor at the session Saturday afternoon. They also deeply appreciated her invitation for those members who could stay over to visit Boxly Sunday morning. How much this meant to those who were able to avail themselves of this privilege is well understood by all who have ever been there.

Mr. Charles Steinmetz, Mayor of the City of Schenectady and Consulting Engineer of the General Electric Co., has an article in the November *Harper's Magazine* entitled "Industrial Efficiency and Political Waste" in which he deplores the lack of scientific method both in industrial and political life.

Mr. Walter N. Polakov will have a paper on "Cost of Electricity" in the next issue of the *Utilities Magazine,* outlining the possibility of putting electric lighting on a scientific basis.

Other notes and information similar to the foregoing, are urgently requested from members, so that due publicity may be given them in the BULLETIN.

SCIENTIFIC METHODS APPLIED TO THE BEATING OF PAPER STOCK[1]

By Arthur B. Green[2]

Notwithstanding the many definitions, interpretations, and ramifications of scientific management that have been put forward in the last ten years, if it is still true, as Taylor so emphatically put it, that "the greatest obstacle to harmonious co-operation between the workman and the management lies in the ignorance of the management as to what constitutes a proper day's work for the workman," then we have in the work of making paper a peculiarly large field for the cultivation of scientific management. It is unlikely that in any other manufacture those on the management side have less precise knowledge of the work of each man and the conditions surrounding it. It is unlikely that the traditional way of running any establishment is more dependent upon the initiative of the workman who applies his skill. And the reason is the old familiar one, that underlying the successful making of fine papers is an art so obscure that it cannot be communicated except through the dumb medium, experience. Whether or not the management is conscious of facing the task of directing the practice of this art toward a given, desired result, still it is almost helpless to discharge that task.

The art which determines the quality of the final result in paper making, more than any other, is the art of beating. That is to say, without going too deeply into the variables entering in the character of our raw stock, and our control over them, if by suitable precise methods, we can turn out from the beating process a uniform result, then the final result as regards character and economy of the finished paper also may easily be made uniform. Following the initiative of our Mill Manager, Mr. Joseph A. Warren, some of us have devoted more than five years to the single purpose of gaining for the management, and putting into use, precise or scientific knowledge of the art of beating. Besides being, so far as we know, the first serious attempt to apply scientific management to the making of high grade paper, the work is interesting because it has called for methods, means of investigation, and a resulting form of organization, quite different from those which we associate with the work of Taylor in machine shop management, though it has been inspired by such work as that, and it is faithful, we believe, to the laws which he so clearly deduced.

Paper is a fabric woven by the accidental entanglement of very small fibres, suspended in water, after the water is withdrawn by draining through a fine mesh. Paper was first made by hand. A pulp, usually from rags, was mixed with water in a mortar and pounded with a pestle. It was then further thinned down with water and put in a tub. A frame, on top of which was a suitable mesh, and under which were shallow suction or vacuum chambers, was submerged in the tub and slowly raised to a level position, the fibres from the pulp being left entangled on top of the mesh. The rest of the process was removing the sheet of entangled fibres from the mesh, "couching," drying in air, and sometimes pressing after drying between hard, smooth surfaces to compact the sheet and give it "finish".

Modern paper making is an imitation of this process, introducing almost no new principles. The mortar and pestle developed through the stamping mill to the present beater, driven by power, the action of which is still largely imitative of the original process. The tub containing the thinned down mixture of pulp has become the "vat" discharging upon an endless wire mesh driven at constant speed, through which the draining occurs in travel. The suction chambers under the old frame, or hand mould as it was called, have become suction boxes operated under the endless wire mesh by pumps. The removal of the sheet from the wire is accomplished continuously by a suitable semi-absorbent pressing roll, called the couch roll; and the subsequent pressing and drying are done continuously also, the latter being hastened by passing the continuous web of paper pulp over a series of steam-heated rotating drums. The improvement has therefore been in productivity more than in any thing else. Extremely fine papers are still preferably handmade.

It is not the present purpose to go at length into the details which are peculiar to paper making. What is interesting for us, who have directed our aims toward promoting the science of management, is the manner in which the work was undertaken, the purposes in view, and the effect upon the relationship between management and workman. Only enough of the technology will be taken up, therefore, to indicate in a brief way the nature of our problem.

The diagram represents the most commonly used type of beater for preparing the mixture of paper making fibres for the formation of the sheet. This is the so-called Hollander type. An open tub T, is divided longitudinally by a partition M, called the midfeather. The pulp is semi-fluid and circulates, as the arrows show, under the propelling action of a heavy roll R, which is fitted with suitable fly-bars, usually of steel. These fly-bars run close to somewhat similar stationary bars of some form bolted together and spaced off from each other by fillers, the whole forming under the roll what is called the bed-plate B. The fly-bars of the roll R, slap the pulp as paddle-wheel blades slap the water; they pound and cut and mangle the fibre between themselves and the bars of the bed-plate, causing some of the effects which it is desirable to produce. The action serves to raise a rapidly travelling film of pulp from under the roll R up over a backfall F, which assists in creating the difference of head back of the roll from that before it which keeps the mass of pulp in circulation. Roll R ought to be driven at constant speed.

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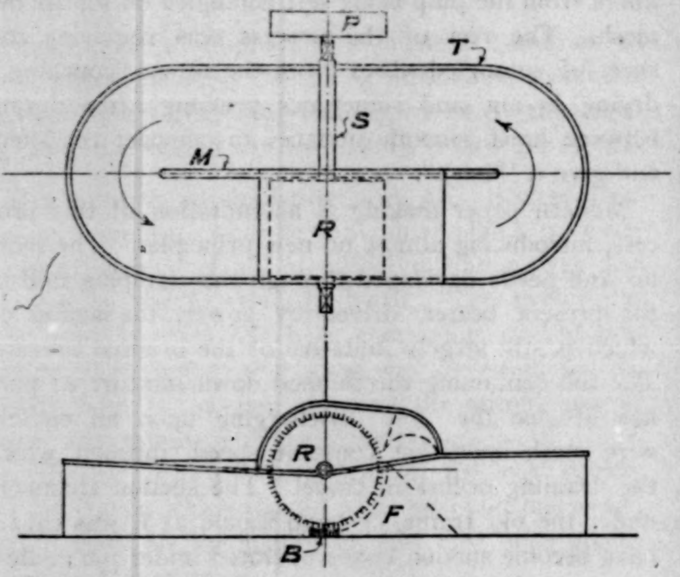
[1] A paper read before the Taylor Society at its meeting in Philadelphia, Pa., October 28, 1916.

[2] Of the Cumberland Mills, Me., the principal works operated by S. D. Warren & Co. of Boston.



The beater is furnished in batches, the composition of which is prescribed by formula. Once furnished, the wetness of the mass being once determined, the only further adjustment that can be made by way of governing the results obtained is the vertical adjustment of the roll R. This and its spindle S and pulley P ride by their own weight on their bearings, which can be raised and lowered through a very small range by hand. As the roll is lowered the distance is lessened between its fly-bars and the bars of bed-plate B, and more of the weight of roll, spindle, and pulley is brought to bear in acting upon the pulp passing through. The entire result is determined for a given batch by this one manipulation. The entire skill of the process is shown in the manner of making successive roll settings while the beating is in process.

There are, of course, other types and designs of beaters, but the Hollander is the most common, and the action of the Hollander is typical of the action of all. Our study as applied to the Hollander is therefore applicable to practically all types of beater.

Simple as is the mechanical principle of the beater, however, and simple also as is the adjustment of which it is capable, nevertheless, the technical discussion of paper-makers is full of speculation as to what happens to the pulp in the process of beating, or what ought to happen to it to produce a given result. The matter is extremely complex and obscure. It is not subject to entire solution without recourse to chemistry, and physical chemistry; and the field is one in which a vast amount of difficult work has already been done with scarcely any profit. In practice, the beater man judges of the condition of his stock by feeling it. His experience enables him to obtain from sensations that which would convey nothing to a new man, a meaning which is clear enough for him to predict pretty well how the pulp will behave when made into paper, and about what quality of paper it will produce. And it is upon this faculty on the part of the skilled beater man that the management depends for the character and uniformity of the paper which it has agreed to furnish. Moreover, paper mills are twenty-four-hour plants, and for every order for paper on each paper machine in the establishment, the management must rely upon the judgment of two or three different beater men and upon their interest in their work.

It is therefore the duty of the management to obtain the knowledge and skill necessary to do what the beater man can do by using his sense of feeling as a guide. That was the object of our work. We had to develop means whereby the management could give to the beater men and their helpers definite duties to perform which could be understood and measured by a competent person not himself doing the work, the result of which would be greater uniformity in the treatment of the stock.

The problem is open to attack in two ways. Study might be made of the various paper-making qualifications of the various kinds of fibres which are combined in the sheet, and of the physical and chemical changes produced in the different fibres under different conditions by different manners of treatment in the beater. It has already been indicated that this course of study has been found altogether too involved to lead to a practical or economical result. The point may be illustrated. During the process of beating, the fibres being of cellulose, there is formed in the mass of pulp a new substance which the beater men call "grease" or "slime". It is an important factor in the quality of the paper, in the expense of making the paper, and in the proportion lost in waste. For hard papers, with high finish, grease is desirable; for blotting papers and "antique" finish, grease is to be avoided. Yet there is no agreement among paper chemists as to what this grease is, where it comes from, or what the action is which produces it; and the research on this point is well nigh continual.

But the mass of pulp making up the batch in the beater has physical properties as well as chemical. The beating action produces physical changes. The minute fibres are altered physically, on the one hand, and the mass itself, considered as a mass, is a semi-fluid, the fluid properties of which change. The nature and extent of these changes are easily measured, and it remains to correlate them with what is desirable or undesirable in the result. This is the second line of attack, the one which we adopted.

We treated the batch of pulp as a fluid mass and studied first of all the physical variables which are set up by the beating action. The mass is stiff at the beginning and becomes more fluid as the beating goes on. Greater fluidity means less viscosity. We therefore applied to the mass a device of our own which we call the "drag" but which the physicist would recognize as a viscosimeter. We arranged this so that it automatically makes a record of every reading at which it stands. Viscosity is composed of two things: the internal friction of the mass which arises from the particles rubbing on each other when the mass is in motion, and the skin friction which arises from the particles of the mass rubbing against a solid body which opposes the movement of the mass. As a result of some careful experiments we established the greater importance of internal over skin friction as a variable to serve as our guide, and accordingingly we built our drag or viscosimeter to emphasize the measurement of internal friction. In order to enable ourselves to draw correct conclusions from our work, irrespective of what may happen to the pulp subsequent to beating, we developed some methods of measuring the paper-making qualifications of the pulp at successive stages throughout the beating process, and at its close.

Very important for the character of treatment which it is proposed to give the stock in the beater, is the thickness, or density of the mixture. Our work emphasized this fact and gave us a measure of it. We found that the drag offered a very convenient way of testing this density, and of getting it uniform in one batch after another.

Again, as the beating proceeds, the drag makes a descending curve of readings. We developed the fact that the shape of this curve, rather than the total change in reading, is the important point for determining the quality of the result. By comparison through a long series of tests, we became satisfied that the drag, with its proper shape of curve, would be a safer and more promising thing to use as a guide than any other device or principle yet in view which deals with the variables that take place.

We have had the drag now in successful use for more than two years in two capacities,—first, as a gage of density for the batch, secondly, as a guide to the manner of treatment. For each order for paper a thickening point is set to govern the density. For each order, and for each beater of the set which is to prepare that order, a standard beating curve is set, by prescribing a series of readings to be reached at definite intervals of time. The kind of skill and judgment employed by the experienced beater man in interpreting the "feel" of the stock is now exercised by the man who sets these curves, and he is on the management side. By these means we have satisfied ourselves that a degree of uniformity in density can be maintained nice enough to govern the ream-weight of the finished paper from the beater room, and a degree of uniformity in quality of paper can be maintained which allows of standardization of grade without confining a large plant to one or two grades. We on the management side have the means of directing in detail the treatment of every batch of stock in every beater day and night, and of taking the full responsibility which belongs to us for results.

Experience has taught us another thing incidentally. While we have been transferring the skill necessary to direct the work, to control the results, and to accept the responsibility, from the skilled workman to the management, we have by no means rendered the beater man's job less skilled or less interesting. We have simply made it precise. We have given him a guide. There is skill in following that guide, of even a higher grade than the skill of going without it, and the beater man always has the advantage of knowing where he stands and how he is coming out. He is protected from unfair blame. He makes much more frequent visits to his beaters, each time to settle a definite question in his mind, each time with a real point of interest before him. Instead of detracting from the fascination of the work, we believe we have added fascination to it.

Again, please notice that since there is skill in following the guide, the guide is not fool-proof. Our instructions are written in precise language; our instruments are instruments of precision; yet anybody who chooses may follow all of our instructions and still spoil the job. The more a man may know about beating, the more thoroughly can he spoil the job and still produce a perfect record. We were aware of this from the beginning because we had tried it ourselves. We are not interested, however, in devising a fool-proof scheme, because it is not fools or mischief-makers that we or any one else want on the job. If a man is with us, and we are with him, he can do infinitely better work and enjoy it far more by doing it right, than he could without the aid which we have placed in his hands; and if he is with us, and we are with him, (it must be stated both ways), he is not tempted to try to beat the game. In short, we have rubbed against another old law, that efficient work comes from within the worker.

It will be noticed at once, that we have made no changes in the design of our beaters; that we have developed no step toward the ideal beating equipment; and that we have not formulated analytically the elements, and how they should be combined theoretically to produce any desired result. To be sure, we think we have some data that would be useful for that purpose; but our object was to control the process, to understand it better than our beater men, to qualify ourselves to direct it in detail day and night for every order that goes through the plant, and to take upon ourselves the right responsibility for the results. It is one of the most interesting phases of the matter, that a careful scientific treatment of the most obvious physical variables of beating, variables apparent to a day's visitor, should have led us so far toward accomplishing this object.

So far as the organization is concerned, one thing is plainly called for. By using the records of the kind of treatment given the pulp which are made by the drags, and by setting the thickening points and drag curves, one man can manage the beating for a large establishment. That is not a simple task, but one man can do it. He substitutes his judgment for the judgment of many individual beater men. He must know the stock, know the beaters, know the results he is aiming to get, and how to get them. The beating characteristics of beaters vary very much as the beaters wear or are repaired, and the raw stock is not constant as to the treatment it may require, or be capable of; consequently, the curves set at one time for a given paper will not necessarily produce it at another time. The work calls for a man of some flexibility. He will be the beating director.

In many cases the quality of paper which the management must obtain is more difficult to handle on the paper machine, has to be watched more closely, and requires unusual and troublesome adjustments for safe running. It is the habit in many establishments to subject the beating pretty much to the direction of those responsible for operating the paper machines, and the temptation there is to ease the beating a bit for the sake of simplifying matters; the result is a failure to realize an especially distinctive and attractive quality. The true guide must therefore be central, subjecting the beating director to instructions which will cause him to produce what is wanted, and seeing to it at the same time that the difficulties of the paper machine room are understood and provided for. The harmonizing of beating and machining is vital, but not to be accomplished best through subordination of one to the other.

It is also a matter of good organization to see to it that the beater men and their helpers are provided with all the materials for furnishing which the formula prescribes, to make sure that the beaters are in good working order, and to see that the working floors are kept clear and clean, in short, to perform all the services to the beater man which really advance his work. It is a matter of fairness to see to it that his record is not lowered by reason of failure of the management in any of these things. It is in the interest of good management and the best results to provide means of recognition, reward, or incentive, inducing that desire within that may result in the very highest class of work of which the beater men are capable; and further, it may be remembered that unless the management is interested enough in doing the job in its own way to stake something on it, no one else is going to care very much. What are sometimes called incentives serve more to show that the management is in dead earnest. They serve to stimulate respect quite as much as effort. Nothing is so fatal to an enterprise of this sort, as to let all hands suppose that the management is only dabbling.

It will also be noticed that we have made no use of this problem of time study. Knowledge on the part of the management as to what constitutes a proper day's work for a workman, is far more important, in paper making, on the side of the character and quality of that work, than it is on the side of quantity. In order to manage, to control, to direct, it is necessary for the management to know first of all how, and later to decide for each workman, how much. There is a large field for time-study, but it is a secondary field. And the beater man himself would hold in little esteem the management that tried to keep his time occupied without first knowing how to do the job.

And lastly, a little plea. There seems to be great turmoil today. We have societies, magazines, clubs, chambers of commerce, and correspondence schools, all talking at once, all anxious to participate in, and to contribute something to, what we call the great present-day movement for efficiency. We ourselves are carrying the discussion out into the realms of social and industrial welfare. We are turning here to solve the problems of unionism, and there, to alleviate the evils of unemployment. We have been getting before us an amazing amount of unrelated problems in the last few years, in regard to which many of us are rapidly developing proposals of great weight. None of these things ought to be made light of, but are we not in some danger of dissipating our efforts? Do we not need definition? Ought we not to become oriented over again? What, after all, is our aim?

The Society, rather than one writer, can best answer the question. Nevertheless, so far as the work outlined above is concerned, the aim has been on the part of the management to obtain knowledge of what constitutes a proper day's work for a workman, and skill to direct that work in detail day and night. Did not Taylor emphasize over and over again, that the lack of this knowledge and skill is the greatest obstacle to hearty co-operation between management and workman? Was he not right? When the American Society of Mechanical Engineers undertook a few years ago through special committee to summarize recent progress in the art of management, the report was that the new element which had been introduced, was the "transference of skill" from workman to management, a really illuminating conclusion, even if it is easily misinterpreted. At any rate, what is new springs from the assumption of new duties and obligations on the part of the management toward the workman which formerly managements did not recognize belonged to them. This, also, Taylor dwelt on again and again. He dwelt on the painstaking hard work, the patient research, and the necessity for "hanging on with your teeth."

Yet, it has been a matter of disappointment to the writer that there have been very few reports to show that those on the management side are digging in to obtain knowledge of the day's work, better ordered and more complete than the workman himself possesses. What progress are we to make, in the long run, unless we do more of this?

DISCUSSION

MR. ROBERT B. WOLF[1]: Mr. Green has certainly demonstrated that it is practical to record the beating operations in a paper mill and I have nothing but praise for the painstaking efforts that he has made to solve this problem. I agree with him thoroughly that there has been very little scientific research work done in this branch of industry and I have always felt that when these problems are approached at Dr. Taylor would have approached them a great deal of guess work and rule of thumb will be eliminated. I say this from the point of view of one who has actually worked in every branch of paper making, for I worked nearly four years in the mills learning the practical parts of the business before going into executive work.

His paper, in spite of one or two reassuring paragraphs makes me feel that he is attempting to have the organization as a whole do entirely too much of the detail work of directing the beating operation; for instance, one paragraph in the second column of page four, reads as follows:

> "It is therefore the duty of the management to obtain the knowledge and *skill necessary to do what the beater man can do,* by using his sense of feeling as a guide. That was the object of our work. We had to develop means whereby the management could give to the beater men and their helpers definite duties to perform which could be *understood and measured by a competent person not himself* doing the work, the result of which would be greater uniformity in the treatment of the stock."

It is not necessary for the management to obtain the *skill* necessary to do what the beater man can do. It must have the knowledge as to why the operation should be done in a certain way; but it is unnecessary for the central directing power to be as *skillful* in doing the work as the beater man himself. Furthermore, the question of understanding and measuring the operation should be very largely a function of the beater man. I do not mean by this that the recording instrument charts that are used in the work should be changed by the beater man, but this should be done by some neutral party whose particular duty it is to look after the recording instruments throughout the plant. I know, however, from my own experience, that it is necessary for the beater man himself, who is actually doing the work, to know more about the operation than anyone else can possibly hope to know, because he is the only man who is in constant intimate contact with the work. The management then should perform the function of co-operating with the beater man to teach him more of the technical side of the question than he himself can know, the beater man contributing the practical knowledge which he alone can have to the fullest extent because he is actually doing the work.

In our plant we make it a practice always when making studies of a particular operation or task to call into consultation as many men as possible who are actually doing the work. Where the group is large we take a representative number and, while in some cases they may not be able to give us any real information, the fact that they had a share in forming the standard practices makes them take an interest in their work, which they would not do to any great extent if they had not been consulted.

Again I quote from the bottom of page five:

> "The kind of skill and judgment employed by the experienced beater man in interpreting the "feel" of the stock is now exercised by the *man who sets these curves,* and he is on the management side."

The question of eliminating the "management side" and the "employees' side" in determining matters of this character seems to me is very important. We try to eliminate this thing as much as possible and make the men themselves *feel* that they have much, if not all to do deciding standard practices. The management should primarily furnish the men with the information necessary for them to intelligently co-operate in determining what the standard practices should be.

Again I quote from the latter part of this same paragraph:

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[1] Manager of Manufacturing, Burgess Sulphite Fibre Co., Berlin, N. H.

> "We on the management side have the means of *directing in detail* the treatment of every batch of stock in every beater day and night and of *taking the full responsibility which belongs to us for the results.*"

Our efforts, ever since we began to realize the workman's point of view, have been *not* to take responsibility from him. It is our plan to *increase* his responsibility and we feel that it is our duty to teach him to exercise his reasoning power and intelligence to its fullest extent. There is no advantage gained by stimulating a man's reasoning power, and through this means his creative faculty, if the management relieves the man of the responsibility for each individual operation. The opportunity for self expression, which is synonymous with joy in work, is something that the workman is entitled to and we employers who feel that management must become a true science must begin to think less of the science of *material* things and think more of the science of *human* relationships. Our industries must become humanized otherwise there will be no relief from the present state of unrest in the industries of the world.

In this connection it might be well to observe that our experience in the pulp industry has been that instructions which go *too much* into detail tend to deaden interest in the work. We realize fully the value of sufficient instructions to get uniform results, but we try to leave as much as possible to the judgment of the individual operator, making our instructions take more the form of constant teaching of *principles* involved in the operation than of definite *fixed rules* of procedure. It is necessary to produce a *desire* in the heart of the workman to do good work. No amount of coercion will enlist him thoroughly in the service.

It has been our experience that this is the only way to get the initiative of the man to the fullest extent and my personal opinion is that the splendid results obtained by Dr. Taylor, in his own individual operations, were due largely to the fact that he stimulated the reasoning powers of the men to a wonderful extent, through his keen insight into human nature. He described to me, on several occasions, how he used the men themselves and made them realize that they were co-operating in obtaining the results.

There is a qualifying clause in column two of page five, which I will quote as follows:

> "We have by no means rendered the beater man's job less skilled or less interesting. We have simply made it precise. We have given him a guide. There is skill in following that guide of even a higher grade than the skill of going without it, and the beater man always has the advantage of knowing where he stands and how he is coming out."

This clause seems to indicate that Mr. Green is giving his men a record of their work, so that they can from day to day see how well they are accomplishing their task. If this is the case, I may have partly misjudged him. I feel, however, that such quotations as I have made previously, added to a quotation from the last paragraph on page five, reading as follows:

> "To be sure, we think that we have some data that would be useful for that purpose; but our object was to control the process, to understand it better than our beater men do, to qualify ourselves to direct it in detail day and night for every order that goes through the plant and to take our own right responsibility for the results"

indicate that there is a very decided effort in his organization to control by "law" and to direct the work of the operatives too much in detail. I cannot see how this can lead to anything but discontent in the organization and I feel that it is necessary for me to issue a warning note of protest, not with the idea of being critical or fault-finding, but with the idea of being helpful to him in his work.

I heartily agree with Mr. Green's plea made in the last four paragraphs of his paper, on page 6, urging our society to concentrate its attention upon the problem of bringing order out of the present great chaotic turmoil in the industrial world of today. I think however, that we will have to change our conception of what constitutes efficiency. This, in my opinion, is not going to be as Mr. Green suggests, a further *analytical* process whereby we can obtain "better ordered and more complete knowledge than the workman himself possesses", but a *synthetic* process which will enable us to build a philosophy of management which will get at the true principles underlying human activity.

The new efficiency is going to reckon a great deal more with the needs of the individual man; but in order to do this it must have some philosophical conception of the reason for man's existence. It is beginning to be understood that when we deny the opportunity to do creative work to vast numbers of individuals we are violating a great universal law.

Man never creates matter nor force, but he *does* create conditions for the expansion of these great primary universal forces and it was for this purpose that man, considered generically, was created. The degree of efficiency of an organization, therefore, can be measured by the extent to which it permits the individual men in its employ to do creative work, which as I have said before gives joy to the worker because it gives him an opportunity for self expression.

I feel that the tendency among many of our scientific management operators is to design an organization that will do the thinking for the man rather than designing one which will *primarily* utilize the tremendous creative forces of the men and stimulate and direct these forces, which when properly controlled will solve all of the problems that have to do with quality, quantity, and economy of operation.

The problem is not how to "obtain knowledge of what constitutes a proper day's work for a workman and skill to direct that work in detail day and night," but how to produce a desire on the part of the workman to do this work well and then, in a much greater measure than we are doing at present, leave with him the responsibility of controlling the details, after giving him all possible assistance to do the work intelligently.

I do not agree with the conclusions of the special committee of the A. S. M. E. that the new element in the art of management can be summed up as a "Transference of skill from workman to management." I read this paper with very much interest when it came out and did not agree with its conclusions at that time.

I believe, as I stated in the paper on "Individuality in Industry", which I read before the Society in May, 1915, that the new element in the art of management is the unifying power of the wonderful mechanism of scientific control through the use of which the organization can become conscious of its progress and deal intelligently with the material forces it is using in converting raw materials into articles of commerce.

It will not, however, be thoroughly scientific until it uses this same organization consciousness to develop the human units, of which it is composed, into reasoning, thinking human beings, giving them opportunity to accumulate experiences and thereby unfold their higher spiritual natures. This is what *esprit-de-corps* means.

Mr. Sanford E. Thompson[1]: I have been much interested in listening to Mr. Green's paper especially as I have had occasion from time to time during the past year or two to learn from him the plans he has been carrying out in developing this feature of the paper-making problem.

It is surprising, unless one is familiar with the paper-making industry, how varied are the problems in management that are presented even in a single mill and the diversities that occur further in different plants.

In this connection, it is well to bear in mind the discussion of the various types of management that were discussed at the Round Table conferences at Ann Arbor last May. In the paper I presented at that time, which preceded the discussion, the types of management in which were variously emphasized, (1) planning and routing, (2) time study, (3) development of standards, are all leading features in different departments of paper mill work. In the Finishing Department, where in some mills there are hundreds of different kinds and styles of paper, planning and routing is the principle feature, with time study and standardization subsidiary to it. Time study, on the other hand, is the chief necessity for handling the department making wooden shipping cases in order to fix proper rates. The third feature, standardization, is most strongly emphasized in the Making Department, and it is this feature which was taken up in such detail by Mr. Green. We find, however, even in the development of standards for beating the paper, that both time study and the planning are necessary in order to attain uniformity in quality and in production.

Our experience has shown it to be necessary to go further back in the operation of beating than the plans outlined by Mr. Green. The exact determination of the furnish, that is, the materials to go into the paper, is a problem which, while appearing simple, is very difficult to carry out. The rags which are used in the paper contain varying amounts of water; the pulp is of different degrees of dryness; the quantities of each of these two materials and of other ingredients used is exceedingly difficult to catch so as to be sure that they correspond in different orders. It is necessary not only to standardize the methods of handling the beating after the materials are put in, but to find some way of accurately measuring the amount of raw materials so that the furnishes of two beating engines on similar paper are the same. The problem, for example, of determining the amount of water in the rags upon which the actual weight used is dependent, is no simple one and must be solved by special tests of samples in special apparatus so as to make the proper correction.

The necessity for standardization in work of this kind is also shown very definitely in connection with the manufacture of sulphite pulp. At the mill of the Katahdin Pulp and Paper Company, Lincoln, Maine, as well as at the Eastern Manufacturing Company, a task and bonus system is being developed based, in most cases, not on the amount of work accomplished nor even on the output, but upon the maintenance of certain standards: the following out of instructions; the adhering to a definite procedure which tests have shown will produce the required results. For example, in the organization of the cooking of the wood chips in the digesters, the bonus is not given for the quantity of the pulp turned out, but for carrying out the cooking operations in accordance with standard curves of pressure and of temperature; for blowing off the digester at the required color of liquor; and for maintaining a uniform (not a minimum) time for cooking. This plan does not by any means take away the initiative from the workman since in order to accomplish the results attained, it is necessary for him to exercise skill and judgment in manipulating the valves, taking the tests, and handling all of his operations. It does give him, however, definite standards for which to work, so that he may have a feeling of satisfaction when these standards are attained; and it gives him a money bonus for proper accomplishment.

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[1] Consulting Engineer, Boston, Mass.

In other departments of the pulp mill, the bonuses are of a similar nature, based always on features for which the men are themselves responsible. In acid making, a given strength of acid is required. In the wet-room, the density of the pulp, that is, the percentage of water, must be maintained within definite limits so as to produce a uniform pulp. In the machine-room are the requirements of uniform thickness of sheets of pulp, uniform moisture, and so on. In other words, all of this means a working to definite standards, which test and experience have shown will produce the required results both as to quality and output. As a result, the men take greater interest in their work, are more careful; and when carrying out the work in proper fashion, they are duly rewarded. The effect is shown in the quality and output of the pulp produced.

I have been interested in listening to Mr. Wolf's discussion of the paper. I agree with him that to maintain the interest of the men in the mill, they must be encouraged to exercise their initiative and to feel that the work is not simply the carrying out of a mere routine. I think Mr. Wolf will agree, however, that the working to such standards as I have indicated does not destroy the initiative of a man; in fact, I noticed during a recent visit to Mr. Wolf's mill that he has prescribed very definite standards over a large portion of his plant and that the workmen are expected to work to these standards.

MR. KEPPELE HALL[1]: I have had some very interesting experiences in my association in this work of management with one of the concerns which has been mentioned here, from the time that the work of developing this system was started up to the present. The particular part of the work in which I have been chiefly employed has not been in the manufacturing of the paper itself. I have been more in the finishing department, rather an outside department. I do, however, know of the conditions that are encountered in the making departments, and I think that anyone who knows what these conditions are in any particular mill, appreciates the more the work done by Mr. Green in his very careful study of the beating proposition.

I think I might possibly clarify matters in your minds a little if I go into some detail in regard to the beating of paper as we have been doing it in the plant of the Eastern Manufacturing Company. Each paper machine is fed, as you might say, by a line of beaters. There are in a number of cases four beating engines in a line. Each engine is filled with various ingredients which go to make up the paper. After the material is sufficiently beaten in the engines it is put in the chest and then taken to the paper machines themselves. The management has now practically the entire responsibility for the furnish. When to make up any grade of paper, formerly rested entirely in the hands of the beating engineer, subject to the rule of the president of the mill. Each grade of paper was supposed to contain about so much wood pulp, so much rags, so much coloring matter, etc. Each grade of paper was supposed to be beaten about a certain length of time. There were no fixed standards as to the things that went into the furnishes or as to the time during which they should be beaten. The consequence was that half the paper was not uniform in strength, finish or other qualities, and the miracle to me is that they came as near to uniformity as they did. It required a great amount of ingenuity.

I have seen samples of paper taken off machines and handed to the president to examine. I don't know what he finds. He takes hold of the paper, wrinkles it between his fingers, holds it up to the light, and then hands it back to the engineer. He turns to the engineer and says, "How much rag is there in this?" The engineer says, "I put in three and a half cars." The president says, "In the next batch put in four." If the engineer had said "Four cars" the president would have said, "The next time put in five." It was a case of guess work to a large extent.

When Mr. Thompson started this work and said to these people that it was possible for them to make standards for these furnishes, they thought of him with pitying contempt. He was frowned upon by the various people who had always done this work, and who said, "The idea of suggesting such a matter of this kind. Work would be taken out of the hands of men who had been making and beating paper for ten or fifteen years." It came to a matter of some sort of a definite written instruction as to just how much of this or that was to be used, and they thought it could not be done; but nevertheless, this was done. Mr. Thompson has spoken of the moisture in the material as being a great factor. The moisture in the material makes it more important than ever to determine just how much of the ingredients go into each particular grade of paper. The kind of materials in this rag stock, and the moisture in the stock, are determined before it is sent to the beater, and accurate amounts are put into the furnish. This results in a much more uniform product, both in quality and strength. This matter of beating has been so standardized that the beating engineer is given his ticket, instructing him that a certain beater is used for certain paper, that the furnish is beaten for a certain time, under certain conditions, and, after a certain time, is taken out of the beater and put into the stuff-chest. Previously that was determined by the sense of touch. The time was practically determined by the sense of touch. The beater engineer would put his hands in the mixture and say that he thought it had better run another half hour. You can imagine that the personal feelings of the beating engineer, the way he felt when he got up that morning, was bound to determine to some extent his feelings when he put his hands in this mixture. That was supposed to be the only way, and the idea of saying that it was possible to beat paper under certain other conditions was tommy-rot. While that is being done by several concerns, we have a regular routing system for beating the paper which differs from some systems. The routing usually is made out in advance for every order, and the beater on which it is to be run that day would get the times the paper would go through the different processes, and when it should be fed to the stuff-chest. These markings are on dials which are set arbitrarily so that they should get started off with zero; and it is set down on the dial how long each particular beater is to run, so that if a beater starts out with zero and runs for two hours, it would be done at zero and two. If it were to be done in two and a half hours, it would read zero and two and a half, and if it were set at two and a half, it would read for two hours, four and a half. Then we have on the routing sheet when the order should be started. This is not the clock time, at which these various beaters are to be filled and timed, but by a process of subtraction from the actual clock time we can give the men the actual time, and they only have to follow the times on their beaters.

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[1] **Eastern Manufacturing Company, Bangor, Me.**

There is one thing that strikes me very forcibly in this matter of beating and making paper. As Mr. Green said, the equipment we are using to-day for beating paper is practically the same as we were using fifty years ago, or even longer. It is a very crude process to look at. I believe, after these investigations have gone as far as it is practical to carry them, and such investigations may extend over a period of a great many years, that some method will be devised that will be an improvement over the present method of beating paper. I say this simply as one who looks on from the outside, and not as one who is actually using the machines. It seems to me, that, when we arrive at an analysis of the various problems connected with the beating of paper, and we have found the value of the different properties in the fibres themselves and their relation to each other, there will be a great many improvements which will take the place of the present methods of beating paper.

There is another matter which both Mr. Green and Mr. Wolf take up in their papers, and that is this idea of the human element in connection with the scientific management of industries. I take issue a little with Mr. Wolf, I think, though I am not quite sure. It would appear from Mr. Wolf's remarks that he was relying more on the individual judgment and initiative of the working man than a great many of us in this room. It looks so, if Mr. Wolf meant that from the very outset the workman should be considered as far as possible in what was being done.

It seems to me that we are not aiding the working man much by giving him at the outset too many different subjects to think about. We ought to give him all the information we can on the subject he is to work with, give him to understand that he is to follow these instructions, and then turn loose his ingenuity and see if he cannot improve on the methods being used. It is as if a man who intended to study chemistry, started out with the idea that he was going to use his own initiative instead of studying the accumulated information on the subject, and began to reason the whole thing out for himself. It is useless to begin the thing that way. It seems to me that it is putting the men on the road to development, and giving them a much better chance to show their initiative, to tell them what to do rather than to make them guess at it. It is my idea that Mr. Wolf has standards in his mill and that every one lives up to them.

To my mind, a big factor is the factor of the human relationship. It is one thing we are emphasizing more and more at the plant of the Eastern Manufacturing Company, and it is the one thing that is indispensible to help on the entire cause. It makes the men feel the responsibility more. We have meetings with the men every Saturday night. We are endeavoring, moreover, to make every employee feel that he or she is getting absolutely a square deal. In the plant we are encouraging them to make suggestions as to how the people in the plant should be treated, and any suggestions of this sort are carefully considered. We have organized a "Service Department" which is essentially an employees' department. The Service Department is their department, and through that department we can move on with the management with the assurance of fair treatment on questions that come up in connection with the work of the employees.

Mr. William O. Lichtner[1]: The problem presented in this paper is extremely interesting to me as it is very similar to the one which I have been directing at the Eastern Manufacturing Company.

The problem of the proper method of beating should not be divorced from the operation of jordaning and the actual forming of the paper on the paper machine, as it is possible to determine the best method of beating to get the strongest pulp, yet when it is put through the jordan and run on to the paper machine it may show very poor strength. To endeavor to standardize the beating, jordaning, and paper machines at one operation would mean a corps of at least half a dozen thoroughly trained men, whose services probably could not be obtained, and five to ten years of solid work,—not to mention the great amount of money required to finance a proposition of this kind.

In view of these considerations, it was decided to do things on a smaller scale, so we limited the investigation to just the beating, and by means of following the stock on to the jordans and the paper machines and by taking tests off the end of the machines, it was possible to proceed with the investigation, as outlined.

What, then, is the problem? The problem is to use the Hollender beater without any change whatever in its construction, to standardize the raw materials which go into the paper, and to standardize the operations. In other words, we expect to get identical results provided we use a definite quantity of wood pulp, of a definite strength, definite quantities of alum, size, glue, gum, etc., each passing certain standard specifications, mixed with a definite quantity of water, and the whole mixture beaten in a definite way.

The difficulty in this proposition is in getting each of the ingredients going into the beater to contain the same amount of bone dry stock per unit of volume. This seems a very simple matter, but in reality is very difficult to bring about. Therefore, we who have spent some years on this problem cannot conceive how it is possible to devise a single automatic mechanical contrivance that will be a cure-all. I fear that Mr. Greene has been carried away a bit from the actual in his enthusiasm over the results which he has obtained. The following quotation from his paper seems to us conclusive evidence that the curves obtained from the "drag" must of necessity be based on average values.

> "Please notice that since there is skill in following the guide, the guide is not fool-proof. Our instructions are written in precise language; our instruments are instruments of precision; yet anybody who chooses may follow all of our instructions and still spoil the job. The more a man may know about beating, the more thoroughly can he spoil the job and still produce a perfect record. We were aware of this from the beginning because we had tried it ourselves."

Possibly Mr. Greene's experience is the one exception that proves the rule, but I have not found a case in my experience where, if instructions are written in precise language and instruments are instruments of precision, it is possible for anybody to follow all the instructions and still spoil the job. In other words, I believe it is impossible to do all that is claimed by means of the *drag alone*, but if used in conjunction with more exact measurements of quantity of bone dry stock of known strength, then it is possible to use the drag for determining the rate of setting the beater roll.

This has been the line of attack which we have been using, and we find it is giving the desired results. Many of the troubles Mr. Greene cites, like that quoted below, will be overcome after he has standardized his beater to where it is fool-proof, and put all the beater men and men on the paper machines on a bonus, so that they all work together as a unit.

This work has already been accomplished at the Eastern Manufacturing Company. As soon as the running list of orders for the paper which is to be run during the next week, two weeks, or even a month ahead, is scheduled, we route the entire work and make out all tickets for each run of paper. The route sheet shows when to fill each beater, how long to beat, when to dump, and the time when the stock will start on the paper machine and be finished. The whole work is tied in for quantity and quality of product. Since the installation of this work according to exact methods, the quality of the product has been improved greatly, especially in respect to uniformity.

Another point to which I take exception is Mr. Greene's statement: "It will also be noticed that we have made no use of this problem of time study." How is it possible then to know how far ahead of the paper machines it is necessary to start the beating so as not to hold up the paper machines, if nothing is known about the amount of time it will require to beat the stock? By Mr. Greene's statement is meant, evidently, that detailed time studies were not taken on the moving of the stock to the beaters, on the filling or the adding of the water, etc.

In conclusion I want to say that my remarks are not to be construed to imply that Mr. Greene has not done a most creditable piece of work. I have had opportunity to know what odds he has had to meet, and that he has overcome them successfully.

I wish to say also that a large share of the credit for the remarkable results obtained at the Eastern Manufacturing Company is due to Mr. Henry J. Guild of that Company.

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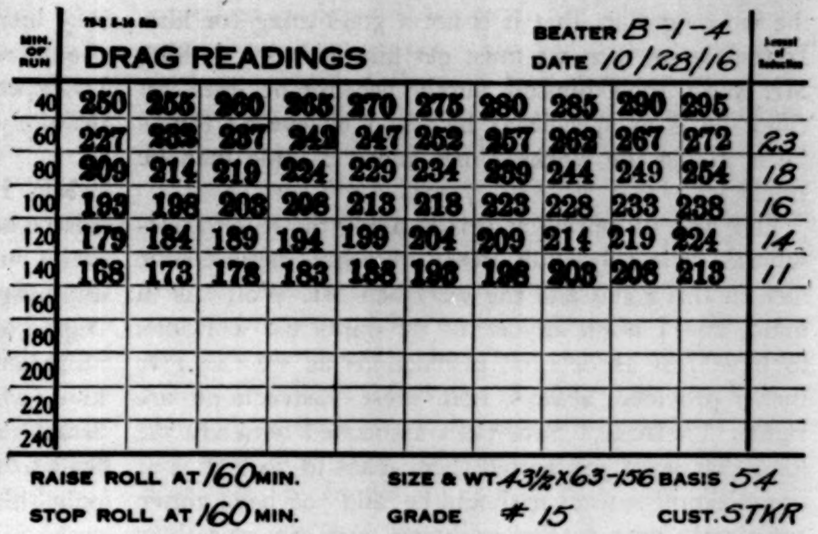
[1] Consulting Engineer, Boston, Mass.

Mr. Hayes[1]: There is another method of beating paper which is used today. I understand Mr. Stobie to be one of the largest manufacturers of paper in this country, and I understand from him that there is a method of beating paper that is absolutely scientific in its operation and control. I refer to the Stobie system, which is used only in his mill. In this beating process they determined the size of a pound of pulp and put it in the furnish at a predetermined pressure, and for a length of time that could be predetermined only by experiment and experience. Now, I have heard what the gentlemen who have spoken upon the strength of paper, etc., have said, and I would like to ask what they have found out about it in connection with the beating in the Hollander Engine, the only one described thus far.

Mr. Green: As I have tried to point out in my paper, the object that we considered the most important, was to control the process of beating as we found it; so we have not undertaken, systematically, the development of any better way of beating stock. There undoubtedly must be a better way to do it. We have visited Mr. Stobie's mill, the Hollingsworth & Whitney plant at Winslow, Maine, have seen the process, have examined samples from the mill, and have satisfied ourselves that it is admirably suited to its use in the making of strong papers. The results are altogether dependent on two simple things, once the density has been fixed,—hydrostatic pressure, and length of time. When a suitably serrated plate has been selected and placed at the proper angle, the control is absolute, simple, and readily recorded. Whether or not it would be preferable as it stands now to our process, that is, for book papers, would be a matter for experiment which would extend over a period of time, possibly short, but very possibly, very much longer than we think, and we have not undertaken it yet. When we do undertake that problem, we shall set out to develop the best adapted process and have an open mind for the utilization of all principles which we can make apply to the problem.

Mr. Outterson[2]: I want to ask a question about standard methods. It seems to me that it is necessary for the discussion to go more into raw materials,—to make the beating more or less elastic. The pulp often varies. It seems to me that the great science of beating is in the beating of raw materials so that they will give a uniform product. I want to know how they are taken care of.

Mr. Green: I had not intended to bore this non-paper-making Society with details of paper technology, but since some are here who would be interested, I might briefly refer to this instruction card. Each column of figures represents a curve of readings which the beater man is to follow. The columns represent parallel curves 5 points apart. You will notice that the first drag reduction called for, between the forty-minute and the sixty-minute readings, is 23 points. If the raw stock is coming hard it will require a more severe setting of the beater roll to produce this reduction of 23 points than if the raw stock is coming soft. Thus, the drag leads the beater man to compensate for these variations in raw stock in the same manner in which his experience would lead him to do, except that it is, to a measured degree in the case of the drag. This takes care of the ordinary fluctuations in quality of raw stock as we find them to occur at Cumberland Mills. The more serious fluctuations, which occur over long periods of time, are compensated for by modifying the set standard curves.



DRAG READINGS

BEATER B-1-4
DATE 10/28/16

MIN. OF RUN											
40	250	255	260	265	270	275	280	285	290	295	
60	227	232	237	242	247	252	257	262	267	272	23
80	209	214	219	224	229	234	239	244	249	254	18
100	193	198	203	208	213	218	223	228	233	238	16
120	179	184	189	194	199	204	209	214	219	224	14
140	168	173	178	183	188	193	198	203	208	213	11
160											
180											
200											
220											
240											

RAISE ROLL AT 160 MIN. SIZE & WT. 43½x63-156 BASIS 54
STOP ROLL AT 160 MIN. GRADE #15 CUST. STKR

Mr. M. L. Cooke:[1] There are two points that appeal to me. One is a point which was suggested to me by Mr. Scheel, that Mr. Green has been particularly interested in doing the work and developing the complete solution of one specific problem out of the whole field of management.

The other point is a discussion of Mr. Wolf's discussion. When I heard that he was not going to be here, I was sorry. I know the problem in his mind would be "what Mr. Green and his associates have done for the poor working man." I think Mr. Wolf is doing this Society a very great service. I feel that anyone who follows his standard and study in this industrial problem must inevitably grow towards Mr. Wolf's position.

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[1] Thompson Paper Co., Philadelphia, Pa.

[2] Carthage Sulphite Pulp and Paper Co., Carthage, N. Y.

[1] Consulting Engineer, Philadelphia, Pa.

I am disposed, however, to think that he is fundamentally wrong in his discussion of the theories. He makes it clear that he believes that the giving of instructions to the men does more harm than good to the working man, that it is not a good thing for him. If that is so, then we must get him over it. I think Mr. Wolf fools himself purely because he does not think he is as specific as he is. I believe he thinks he is giving the working men more latitude than he really is.

One way of getting at it is to apply the rule to ourselves. It is only a difference of degree between the men in this room and the workmen Mr. Wolf has in mind, and I think anyone of us wants the workman to have just as detailed instructions as we can give them, provided always that these instructions are right. The men I have been associated with are the kind that want you to tell them what to do. If your organization is what it should be, and you have gotten sufficiently near to the workmen, you can give them material to make up, and they will make it according to the instructions. It is not necessary to give them an opportunity to develop this creative power Mr. Wolf speaks of. Mr. Wolf has given us a question to keep before us. There is a very grave difference of opinion between Mr. Wolf and a great many of the men in this Society.

Mr. H. K. Hathaway[1]: Following up Mr. Cooke's remarks, I have something to say,—namely, a rediscussion of Mr. Wolf's discussion. In the first place, I am very glad to see papers now in the Society dealing with the application of the Taylor principles to the industrial problems. I think we want to operate with the principles of the Taylor Society as they are concerned with the application of the teachings of Mr. Taylor to industry. That application involves a great many things. First, the fact that we are the instructors, second, the development and training of the working men, third, co-operation, and fourth, the proper assumption of responsibility on the part of the management. If we must refrain from giving instructions to the working man we are not applying that principle, so invaluable, in which knowledge must be given to the workman for this scientific training. You cannot train him on instructions; you can only assist him in that training with definite instructions. We cannot convey our ideas to the workman and let him work them out for himself without any instructions. In this particular detail Mr. Wolf is wrong. What right have we to suppose that any workman is unwilling to be taught, provided we do not insist upon his going to school for that teaching? We have a certain belief that education is good for the workman. Mr. Wolf has that idea; why, then, should he emphasize unduly these ideas of individuality upon his people? We can easily see that it is perfectly ridiculous to teach people how to play or to work, if what they learn is wrong. It may be desirable that people should receive all their education in school only, but by experience, I believe, we can teach them just as definitely as anyone else.

Mr. Hayes: In regard to Mr. Wolf's methods. I have been through his mill, where he does his work, and I might say that he has not endeavored to keep anything from his workmen that will in the slightest degree help them. I do not know that there is anyone more anxious to give them help than he. I do not know where anyone gets a different idea. I did gather from one or two of the speakers that he does not intend to give his workmen what they require, and the only thing I can say about this is that it is not the case.

I think at Managunk we have been unconsciously applying some of the Taylor principles. We feel that the men have to some extent profited by a few of the things that have come up from our efforts. We have lately been training each workman in each department, and the progress has been very satisfactory indeed. Every day we take a record of the work done by each man. These records are given them when they are 24 hours or less, old, in the business. We had a discussion as to whether or not to do this. We did not know whether they would take it gladly or not. They did welcome it, however, and every day they are anxious to see what their record for the last day was. It results both in a greater uniformity of work, and in better work. Very many times suggestions come from the men which help us to help them. It is our intention to help them through their own suggestions, but we will work their own suggestions out for them. We are certain that the results are a good bit more certain.

In regard to the piece work proposition, we have had several different kinds of payments. We have had some piece work, some bonus, and some hours per day. One of the first things that the men thought of was a way to help us to help themselves. Then their time,—why they were making 50 per cent more on piece work than on day's work. Formerly they had been wasting time, but it now has come to a point where they do not waste any time. There is an incentive for them to work, and there is some reason why they should. They like the new way, and would not now go back to the old way. We find that these principles apply to the whole factory. In the box making department, mentioned by Mr. Thompson, we are certain that the men are better satisfied with these methods than with the old method, the day wage.

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[1] Consulting Engineer, Philadelphia, Pa.

Mr. Green: Gentlemen, I should like, with your permission, to take up with great brevity, one or two technical points which my original paper was not intended to emphasize, and then to proceed to another brief consideration of the human side. I value what has been said, and I am grateful to everybody who has discussed the paper. Many points have been brought up which will be inspiring to me in going ahead further.

You remember it was suggested by Mr. William Kent that we could use other means than the drag in studying the problem. I want to remind you again, that this was only a report of progress. In our work we used many other schemes, and our endeavors were centered upon trying to ascertain which gave the most practical results.

I don't intend to bore you with a great deal of technical detail. I hope to place the matter in as full technical detail as I know how before the Technical Association of the Pulp and Paper Industry.

Mr. Lichtner, in speaking of the matter of density, pointed out a different way of supplying the beating machine. At his plant they don't have any stock come in slush form. In that case another method of determining and controlling density may be preferable. There are other ways of doing it, but to take advantage of the slush form of our soda pulp delivered to the beaters by pipe lines was extremely easy. Mr. Lichtner questioned whether variations in speed of turning, of the stock in the beater would not throw the drag readings up or down to the extent of spoiling our control of density. At the time of reaching the thickening point, the speed of turning in all engines is very slow, and is not variable to any practical degree from one time to another. Differences in hydrostatic head on the drag bulb would also introduce errors, but this we have independent means of controlling.

Mr. Lichtner was also concerned as to the fact that a man can follow our instructions and still spoil the job. If so, he asks, have we really got complete control of the man's work? I don't know of any set of instructions, from the law down to instructions given to workmen, that a man cannot beat if he wants to. The way the men can beat us is this: We will assume that the thickening point has been reached and the roll set down to working position. Now, we allow forty minutes for some additional chemicals to be added to the stock and the mixture to be evened out before we take the first reading of the card. During those first forty minutes, if he does not set his roll right, he will spoil the stock. A man tried it on us once and we suspected him. He was setting his roll altogether too hard during that first forty minutes, then easing it so as not to over-run the sixty-minute reading. In that way he got a perfect record, but the stock was so "slow" as to crush and suck the wire to pieces on the paper machine at 30 feet less than standard speed for that order. I walked in on him and walked around the place. His instructions were not changed, and I gave him no new instructions. Yet when I was there everything went nicely. He had thought he could fool me. He had played a little game on me on the night shift, and we tried to get him to stop playing those games, and if he had he would still be with us. A man who plays games with his work is not the type we want under any system. If the beater man and the management are working together, he will use the roll to the best advantage during that first forty minutes and he would only have to study the instructions given to him to get his future results right. He knows that is the best thing for him to do, and he does it. If he is working against us, he can beat the game in the way I have described. However, he cannot do it very long, and therefore we have control of the job.

I am extremely interested in the work which is being carried on with the Eastern Manufacturing Company under Mr. Thompson, and for our part at Cumberland Mills we wish for the most open kind of co-operation between our work and theirs, and we have already endeavored in one or two ways to serve them. As to the discussion of Mr. Wolf's paper on the human side of the problem, it has been handled so much more ably by those who have discussed my paper that I doubt if anything more is needed from me, except to say that I agree with Mr. Wolf's critics on the whole rather than with Mr. Wolf's paper as he has put it. He and I seem to need the opportunity of talking it out together.

I would like the opportunity of using the time that I would have used for that discussion by saying how the beater men feel about our work, and also this: during the period that we have been engaged in this work, we have been right in the beater room. We have worked right with the men, and we did not try to exercise any authority over them. We put up with all the conditions that they did, and we did that to get ourselves qualified for the study. That was our idea, to qualify the management to carry on its own beating. Now that they have been at it for a little while, the men are finding that they like to follow these instructions better than they liked the old way. I was very much interested a short time ago to have an old man, who began his career in the beater room on the 1st of February, 1857,—and he is still on the job, taking night tricks, as well as the rest of them,—come to me and voluntarily say that since his drags have been limbered up and have been working all right, he likes to do his beating by them better than by the other way, the old way; and he had been doing it the old way for 59 years.

THE PRESIDENT: I do not know whether I should participate in discussion; at least I have not before done so. But I should like to say something in connection with your discussion of Mr. Wolf's discussion. Mr. Wolf has just been lecturing before our students at the Tuck School, and I am convinced that he has a big idea. I wish I could talk in the light of a trip of inspection we plan to take to his plant next week.

Mr. Wolf is emphasizing individuality in industry. He believes that any member of an organism,—say a group of workmen in a plant,—must have individuality, which requires that, in so far as the member has consciousness, there must be opportunity for creative effort interesting and inspiring it. Now I am inclined to think that, just because Mr. Wolf emphasizes individuality, he leads you to believe that there are no instructions, no control. I believe there are probably pretty strongly governing instructions in his plant. But they take the form of information concerning methods and results rather than of minute regulatory propositions. I understand that Mr. Wolf's workmen are furnished daily an extraordinary amount of information concerning the results of their individual and group operations, and concerning operations throughout the plant. This information inspires them to attempt, on their own initiative, to perform operations in accordance with the best methods which are taught them. The instructions, therefore, instead of being minute, take the form of advice concerning exactly what is to be accomplished, the best way of accomplishing it, and the results of efforts to accomplish it. The application of individual skill to the accomplishing of the desired result is the independent creative effort of the workman.

For instance, a workman is in charge of a digester. Before him is a graph showing the ideal curves of gas pressure, steam pressure, etc.,—varying at different stages of cooking,—which must be maintained to secure the desired quality of product. The workman watches gauges as cooking proceeds, and *on his own initiative, as his own creative effort,* manipulates values with the purpose of keeping the actual readings, or curves, in conformity with the ideal curves. We have a combination of general instructions with individual initiative and creative effort. The proportions might not be the same for all industries.

We must not be unmindful of the results of Mr. Wolf's application of his principle. He has changed the reputation of his plant to one esteemed for high quality, even-running product; he has increased the output some ninety per cent with the same combination of labor and equipment. These are facts to establish a presumption in favor of his philosophy.

SCIENTIFIC MANAGEMENT[1]

BY H. S. PERSON, PH. D.[2]

I consider it a great honor to be invited to speak to a group of the personnel of the Wm. Filene's Sons Company. It is almost like carrying coals to Newcastle to talk about good management to such a group. Your presence here expresses a praiseworthy principle of human nature: the more completely one recognizes and appreciates a good thing, the more one wishes to know about it, and the more one strives to perfect it.

I am going to talk about Scientific Management from the point of view of the manufacturing plant, in the hope that you will receive suggestions which you may carry over into your problems relating to distribution. One has to talk from the point of view of the manufacturing plant because it was in manufacturing that Scientific Management was first worked out, and, if we speak accurately, is today the only field where its principles are in anything like complete application. The point of view and the methods of Scientific Management are being applied to problems of distribution, but the application in that field is infinitely more difficult, and is only in its beginning.

I took the liberty to ask those who arranged the course what was desired of me, and they gave me eight topics. I shall talk to you from the point of view of those eight suggested topics.

BASIC PRINCIPLES—SOCIAL AND INDUSTRIAL

What are the basic principles of Scientific Management, industrially and socially? Historically, Scientific Management was not worked out as the expression of any basic, industrial principles: that is to say, it did not originate in the mind of any man as a detailed and concrete expression of some body of principles in his mind. Mr. Taylor, a foreman over a group of working people, was concerned with the practical problem of making his foremanship successful, and worked out certain detailed methods of control, and made investigations related to the problem of control for a great many years. If he started with a basic principle at all, it was this: investigate thoroughly before you conclude what to do and how to do it. He investigated thoroughly, came to conclusions how to solve certain practical problems relating to the control of the operations of a shop, and then after going over these practical conclusions discerned that there were in them certain universal principles of management. These he presented in a paper before a body of engineers. But few of his auditors grasped their significance; one or two did, and these men in discussion said they were revolutionary, not only from the point of view of management, but also socially and industrially. Since then there has been a growing appreciation that Scientific Management represents new industrial and social as well as managerial principles.

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[1] A lecture delivered before the Filene Coöperative Association, an organization of the employees of Wm. Filene's Sons Co., Boston, Mass., in its business course. Printed here by permission.

[2] Director, Amos Tuck School of Administration and Finance, Dartmouth College, Hanover, N. H. President, Taylor Society.

The fundamental industrial and social principles are two:

I. It is a method of management which permits a greater satisfaction of human wants from a given quantity of material, capital and labor. It is a fundamental principle which is not disputed, that the total income of all of us, in the form of wages, interest, rent and profits, is limited by the productivity of the combination of labor, machinery, raw materials, and so forth, at our disposal and we cannct have a larger income than can be derived from the best known technical methods of combining these. There is no way of increasing one's share of the total income except at the sacrifice of another party, or by making total production more efficient. Now Scientific Management means greater technical efficiency, and therefore greater total income, which will result in greater profits, higher wages, or a shorter working day, or in a combination of these, and in general in the satisfaction of more wants than we are now able to satisfy under present operating methods.

II. The second fundamental principle—I think it may surprise some of you—is the principle of democratization. There are a great many who conceive of Scientific Management, through its centralized control, as working against the democratization of the whole combination of working people. It means the reverse, I believe, for the following reason: It seeks exact information, which it does not conceal. It pools the information ascertained so that everybody can have it. It is recognized that it makes much more efficient and independent the average of ability. You go into a Scientific Management plant and you will find that the Order of Work Clerk, the Production Clerk, those in immediate supervision of control of the processes, have nearly all been drawn from the ranks of working people. It discovers, records, and pools information in such a way as to make more efficient and much more productive the average ability, such as we all have; and as a result it makes it possible for industry to rely less on genius and on intuition. Another reason for its influence towards democracy is that it is conditioned upon co-operative good will.

There are two fundamental principles: (1) the industrial principle of greater satisfaction of human wants from a given amount of equipment and material; (2) the social principle of greater democratization in industry.

PLANS AND POLICIES

I interpret "Plans and Policies" to ask me what is the object of Scientific Management and what does it purpose to do in actual operation? First, I want to speak about the plans and purposes of Scientific Management as concerning productive processes; after that I want to say a word about the plans and policies as they concern the distribution of the income which results. Keep those two points separately in mind.

1. *Aims, plans, policies and methods as they concern productive processes.* As I analyze it there are three principal aims in it:

(1) Seeking of more precise information through investigation, experiment, etc.

(2) As great an amount of prediction of what is going to happen in business operation as is possible on the basis of the unusual amount of exact information acquired.

(3) Precise control of the processes of conducting the business by various functionalized people in such wise as to bring about as precisely as possible the predictions which have been made on the basis of the exact information required.

I think that is a somewhat new analysis of the aims of Scientific Management, but I believe it is absolutely sound.

(1) Seeking of more precise information. It is in the Scientific Management plant that investigation and experiment,—the establishing of an experiment room with adequate equipment under the direction of capable investigators, have been worked out. It is in connection with this investigation and experimentation that time study has come in. I cite it as a method of acquiring precise information. Time study simply means a method of acquiring exact information with respect to the time which it takes a person to do a certain thing, with certain definite equipment, under certain definite conditions. If you know that—the time it takes a person to do a definite thing, with definite equipment, under definite conditions—you have a piece of precise information which you can use in prediction if you receive an order to make something. There has been a great deal of abuse of time study, because it is one of those things of which it is easy to comprehend the possibilities; because it is easy to buy a stop watch; be-

cause it is easy to put over the bluff of using it properly. The stop watch has been used injuriously by unskilled persons. The scientific use of the stop watch is to take unit times. It has been applied to a good many varieties of work. Take brick laying, because that is a classical case of the application of time study as a method of scientific investigation. Brick laying has a great many variables, such as windows, corners, the nature of the courses, etc. Now, Scientific Management investigators have worked out the time it takes an ordinary skilled brick layer to lay a single brick under each of every conceivable condition. They did not find out how long it takes to lay fifty feet of wall with all sorts of conditions, but how long it takes to lay one brick under any condition of bricklaying. Suppose a contractor receives an inquiry to bid on laying a wall. He receives the specifications and analyzes them: so many corners; so many windows; so many feet of plain wall between; so much face brick; so much filling; etc. By multiplying the number of bricks to be laid under each varying condition by the average time of laying one brick under each condition, he can compute readily an average over-all time for laying fifty feet of wall with all the specified conditions of windows, corners, etc. I give you that as an illustration of the extent to which this precise information is sought, and also as an illustration of the exact prediction possible in the light of precise information.

(2) Precise Prediction. If one by time study and other investigation has secured and filed information telling the time of performing a unit operation with certain tools and materials under certain conditions, then if an order comes in to do or make something which represents a combination of these unit operations, by a simple mathematical calculation it is possible to determine how long it will take to fill the order, what materials and tools must be provided, what conditions established, when work on each part should begin, when and how they should be assembled, etc. In other words, an accurate layout of work on the job becomes possible. In most plants layout is by guess. Guess involves waste. An accurate layout of separate jobs means accurate layout and dovetailing of all jobs, and economical and efficient operation of materials, equipment and labor; in other words, more precise control.

(3) Precise Control. This means that to each of a number of persons shall be assigned, with authority, the responsibility of maintaining one or more of the standard conditions on the basis of which the prediction or layout of a job is made. The principal standard conditions to be maintained are

(a) Standard materials. All materials purchased should conform to carefully-worked-out, detailed specifications. It is surprising, if this is not done, how great variations there may be in materials received, without violation of the terms of the purchase and grounds for rejection. Materials purchased by detailed specifications, however, should never vary, and should give always the same reaction to the application of the labor of foreman and workman.

(b) Standard storing and issuing of materials. Materials should be under the custody of a person who will issue them only at the time, to the workman, and in the quantity specified by the person who lays out the job. Thus is avoided that surprising, unintentional waste which results from permitting Tom, Dick and Harry to help themselves to material at their pleasure.

(c) Standard conditions under which work is performed. Someone to whom such responsibility has been assigned should relieve the workman of the necessity of maintaining the most favorable conditions of work. The most favorable conditions of work involve many elements: heat, light, availability of material, perfect conditions of machine, bench, tools, belting, etc.

(d) Standard methods of performing operations. This is the responsibility of the foreman and workman. When a job is to be performed, it should be performed by the workman according to the best known method determined by experiment, and nothing should detract the workman from that responsibility. His standard materials have been brought to him; the perfection of the conditions in which he is to work has been provided for; another has seen to it that his machine and tools are in perfect condition and ready; his responsibility is to perform the operation. And he, as well as the person who has laid out his job, should know how long it will take him to perform it, for every condition of operation is predetermined.

There are other elements of precise control which I might describe to you, but I feel that I have made clear the nature of it in describing control of materials, conditions and processes. Do you not see that much waste of material, labor, machine, time, etc., is impossible with such control?

Through what machinery are the three primary aims of Scientific Management (investigation, prediction, precise control) accomplished? This machinery is described in the words *functional organization.*

You have functional organization in this merchandising house, and you know what it is. It is carried out to an unusual degree in manufacturing plants by Scientific Management. First, there is functional organization in the large; planning is separated entirely from doing. Now, in an ordinary manufacturing plant an order is received to make something. That is sent down to the foreman with an order to "make twenty-five of these by the 25th of June." The foreman turns to the workman and says, "Start on these day after tomorrow." There your foreman has planned who is to do it; how long it will take; how it is to be done; and so on. Under Scientific Management, on the other hand, in a room called the planning room, where is kept on file all the information which has been gathered regarding all phases of operation, the planning is done. First, a list is made of the operations involved in filling this order, and of the materials and equipment required; second, an estimate is made of the time it takes to do each one of the operations with due allowance for uncertainties; third, a day is determined when work on the order is to start in order to meet the date of promised delivery. All planning of that sort is done, and proper orders are made out. On the proper date these orders are issued to the man who has charge of the material, telling him to send it to such and such a machine; and to the workman at that machine, telling him to start the work. Accompanying the order issued him is the analysis of the job and definite instructions for its performance. You know the story of the German General who made warfare scientific. The story is that he was awakened from his sleep and notified that war with France had been declared. He said "Pigeon-hole A" and went to sleep again. When he awoke, mobilization was on. He had filed in the pigeon-hole "A," ready for the emergency, precise directions for conducting it when it should come, and precise telegrams to commanders and officers. That is what planning in Scientific Management means.

I have been speaking about functional organization in the large—the separation of performing, planning and investigating. There is also functional organization in detail. The best illustration is any shop where working people are. In the ordinary manufacturing plant there is one foreman directing the work of the shop. He hires the workmen and discharges them; he tells them what to do; when to do it; how to set up the machine; he inspects results; and so on. Now under Scientific Management the way that would be handled is this: Suppose you have several shops in your plant, each with a foreman with all these responsibilities. One of these men is extra good at directing workmen how to do the work; another man is very good as what we call a disciplinarian,—he can talk tactfully with the workman who is not doing his work right, and straighten out the situation without causing friction; another one is excellent in the technical side of setting up machines. Now, you say to them that instead of each man having a room, and being responsible for everything pertaining to that room, each shall be responsible in all four shops for that in which he is particularly strong. One man, perhaps, will do nothing but instruct workmen in all four rooms; another will be disciplinarian; another will do nothing but hiring, because he is strong in that; etc. This is functionalization in detail.

I have been talking concerning plans and policies as regards productive processes. A word about plans and policies as concerns sharing in the rewards.

II. *Aims, plans, policies and methods as they concern the distribution of the total income which results.* The particular productive processes which I have described to you produce more with a given combination of materials, equipment and labor than any other productive processes that have been worked out. What is the theory of Scientific Management with regard to the sharing in this extra income? Now Scientific Management is not tied up to any theory of sharing at all. That should be clearly kept in mind. You can have Scientific Management under a regime in which the proprietor takes every bit of the extra income. You can have Scientific Management under a regime in which the workmen get all of it. There is no definite relation between your theory of distributing your income and this technique of management. You can have Scientific Management under the present prevailing system of what we know as individual ownership and control; you can have it under that possible and, as some people believe, probable form of control in which through co-operation the working people own the business and hire a manager. There is no fixed relation between the philosophy of management and of distribution. Scientific Management can be applied at any stage of our industrial progress, under the particular philosophy of ownership and distribution then prevailing. Under the prevailing theory of individual ownership and management, it would be possible for the surplus income of Scientific Management all to go to the proprietor. As a historical fact it does not. The managers have always shared this increased productivity with the working people by increasing wages, and with the consumer by lowering prices. This is how it works. I am saving on costs. I am convinced that the saving will be permanent. To get more trade I lower my selling price slightly. I lower it to the extent necessary to get the trade, and increase my business to the extent I want. Thereby I am sharing part of this increased income with the consumer in lower prices. Furthermore, this policy of precise investigation, precise prediction, and precise control of operations so as to bring about what is predicted, is based on, and conducted on, a spirit of goodwill and co-operation of all workers concerned, and therefore, historically, without reference to any theory of distributing social income, simply as a method to secure the goodwill of everybody concerned, the management has in every case increased wages voluntarily. This precise control requires that everybody shall agree to assume responsibility for doing the particular thing assigned to him or her without fail. It never will work without the spirit of co-operative assumption of responsibility, and one of the first moves of the managers who put in this type of management, whose whole bringing up would be to take all the profit they can get as long as they are paying running wages, is to increase wages very considerably in order to get those things absolutely essential to precise control—goodwill and co-operation. If Scientific Management is working successfully in any plant, it is proof that there is fine spirit there, because it would fail without that spirit. This increasing of wages and salaries by owners because they do so as a means of securing the goodwill essential to precise control, has developed with discussion and with the enlightenment and broadmindedness that has come from discussion, so that the dominant motive today as contrasted with ten years ago is to share the increased profits as a matter of social justice, a very radical modification in motive resulting from largeness of mind. That is one of the effects of this philosophy of management.

DEVELOPMENT OF SCIENTIFIC MANAGEMENT

It is pretty hard to trace this development. The number of places where real Scientific Management exists, contrasted with the number of the businesses in the country, is so small that it is difficult to say that there has been any development in it. You must distinguish between real and fake Scientific Management. It is like real religion and fake religion; real anything or fake anything. Now from the point of view of professional practitioners of real Scientific Management the development has been slow and sudden. Back in the eighties Mr. Taylor conceived the idea that his problem of management could be solved only by knowing more about his business and having more precise control of operations. Now a great many men would have rushed into print with results within twelve months. Mr. Taylor took twenty years at that problem, and worked the whole thing out in his own shops before he said a word in public. In 1903 he made an address before the American Society of Mechanical Engineers, a classical statement of his philosophy of management, called "Shop Management." Only one or two of that body of engineers, highly trained men, grasped the significance of it. Mr. Towne, in the discussion following the paper, said it was revolutionary. He prophesied it would be one of the greatest contributions to industrial life that had ever been made. But referring to managers as a whole, the significance of it was not grasped. We did not hear much more about it until in 1906 Mr. Taylor published a paper on "The Art of Cutting Metals." That was hailed the world over as a great technical paper on the cutting of steel. Few saw the philosophy of management in it. In 1910, a very brilliant lawyer, representing the shippers before the Interstate Commerce Commission, in a case between the shippers and the railroads, —a brilliant lawyer, and I am glad to say one of our Supreme Justices (applause)—I am glad to see that others agree with me—saw how he could make his point before the Interstate Commerce Commission, and over night the country heard of Scientific Management, and then there began to be a good deal of thinking about it. It was at this time that the public first grasped the significance of it. A dozen or fifteen men who represented real Scientific Management had been practising quietly, but it is not the kind of thing that can be spread rapidly. It is not a machine that you can build and ship to a plant and put in. Scientific Management means going into every separate plant and working it out there according to the local conditions. That requires two things— first, a man capable of doing work, of breadth and vision; and second, time. Scientific Management is bound to develop very slowly. I do not believe there is real Scientific Management in fifty plants in the country. I do not know of that many.

There is a development you cannot measure that has a great significance. That is the growth in the public mind of the idea of Scientific Management and inquiry concerning it. You cannot measure growth of that store.

RANGE OF APPLICATION

In the first place Scientific Management has been applied almost entirely in manufacturing establishments, for the very obvious reason that manufacturing operations are capable of much more precise control than merchandising operations, and the operations of auxiliary businesses. Second, the demand for the services of the men capable of applying Scientific Management in these manufacturing industries has been so great as to absorb nearly all of their time. They have not had deliberately to pick out the hardest industries. A number of applications were first worked out in machine shops, and most illustrations are naturally from that industry. As a matter of fact, without any literature resulting from it, the philosophy of Scientific Management has been applied to a great variety of industries, represented by such a variety as iron and steel, books and binding, textiles, clothing, building construction, and even banking.

It is very interesting to know that the exponents of Scientific Management are now educating the public with respect to something they have known but which the public has not—that Scientific Management is not a rigid thing. It is not the same here and there, but must be different in every kind of plant, because of different local conditions; and in different types of industry different features of the mechanics and principles must be emphasized. They have worked out three principal types of industries:

1. Industries with continuous processes; uniform product with uniform specifications; single purpose machines; uniform operations; simple routing. Illustrated by the manufacture of paper and pulp.
2. Industries with non-continuous processes; uniform product with varying specifications; single purpose machines; uniform operations; simple routing. Illustrated by the manufacture of envelopes, books, and handkerchiefs.
3. Industries with non-continuous processes; varying products with varying specifications; multiple purpose machines; varying operations; complex routing. Illustrated by machine shops.

EFFECT ON PRODUCTION AND DISTRIBUTION

Where real Scientific Management has been applied there is observable the following effect on productive and distributive processes,—all resulting from precise control made possible by intensive continuous investigation:

1. Greater efficiency of the individual workman, without greater expenditure of physical and nervous energy.
2. Greater efficiency of equipment.
3. Greater efficiency of material.
4. Resultant lower costs, greater profits, higher wages, and in many instances lower selling prices.
5. Greater precision in deliveries.

EFFECT ON THE INDUSTRIAL WORKMAN

I do not know of any phase of the subject about which there are more incorrect statements, based either on prejudice or ignorance, than the influence on the workman. There is only one safe way to know what the facts are: that is to go and visit real Scientific Management plants. You cannot rely on printed literature. These misleading statements are in many instances deliberate falsehoods, but on the whole, I believe, rather a misinterpretation of facts because of the bias of some industrial philosophy. I am going to present the following generalizations based on personal observation and inquiry, concerning the effects of Scientific Management on the individual workman.

First: The health of working people is not impaired, but on the other hand is usually improved by the better general working conditions established.

Second: There is always increased wage. In some cases it is very considerable—twenty-five or thirty per cent. Where it is not as considerable as that it takes the other form of shorter hours. In many cases it is a combination of increased wage and shorter hours.

Third: The attitude of mind and spirit of the working people in the plants I have inspected is conspicuously better than the attitude of mind and spirit I have seen under other types of management. Scientific Management to survive, depends upon that thing. The idea of precise control is impossible without it.

Fourth: Contrary to your first impressions, based upon misinformation and upon a misconception of the nature of standardization, Scientific Management offers a greater opportunity for the promotion of working people freely from one position to another.

Fifth: According to my observations, as a result of the spirit in the plant, and increased wage, and sometimes shorter hours, the standard of living of the working people is more satisfactory than that which accompanies ordinary conditions of management. This results not merely from the ability to enjoy more things; it arises also from a different attitude toward things and toward each other.

Finally: I think I see in it the opportunity for regularizing employment. One of the serious social problems confronting us is irregularity in employment. I do not see any possibility of regularization without precise knowledge of facts, ability to predict, and precise control; and one plant—a Scientific Management plant—has had the nerve to tackle the problem of regularizing employment by deliberately not making all it can in full season and holding production over to the dull season. It feels confident of what it is doing, because of precise knowledge and precise control of its operations.

These effects of Scientific Management on the individual workman, reflected in the home and multiplied by the number of homes, represents its effect on the community. Higher wages make possible the enjoyment by the community of a greater number of things of life, and shorter hours of work afford the time for this enjoyment. The spirit of "the best way" and of "the reason why," developed in the shop, is carried into home and community life, as is also that broadmindedness and tolerance which develops with co-operative activity.

MODIFICATIONS OF SCIENTIFIC MANAGEMENT

Just as there were fake physicians and shyster lawyers when medicine and law were young professions, so we have at present fake organizing engineers. They do as much damage to the plants by which they are engaged as the fake physician did to the health of his patient. I wish it were possible by some sort of prescription to abolish these fake and damaging self-styled organizing engineers. I do not see how that can be done. We must rely upon the education of the employer, his refusal to employ them, and their ultimate extinction by starvation. The point I have just made does not concern the topic "Modification of Scientific Management," but it does concern the modification of the circumstances in which real Scientific Management finds itself.

I would not suggest any modification of Scientific Management, for Scientific Management is an attitude of mind rather than a physical thing. It is a body of principles rather than a mechanism. Who would suggest a modification of the three fundamental principles I have attempted to bring out? (1) Continuous and intensive investigation of facts. (2) Prediction, so far as it is possible, on the basis of the facts ascertained. (3) Precise control of materials and processes so as to make actual operations conform to the facts ascertained by investigation. I cannot think of three more satisfactory universal principles.

Their honest application involves the idea that there shall be a strict regard for the exact facts surrounding the conditions of any particular application of the principles of Scientific Management. The consequence of that is that the mechanism and external manifestations of Scientific Management must in any particular plant be more or less different from those in any other particular plant. In that unreal sense of the word "modification," we may say then that there must be a modification of the mechanism of Scientific Management with every application of its principles; but its principles remain the same, for it is a corollary of the principles enumerated above that accurate investigation of every separate plant will find a separate combination of facts that will require separate application of the principles.

SCIENTIFIC MANAGEMENT AND FILENE'S PROBLEM

I take up this point by request and not voluntarily. I am not so presumptuous as to attempt to suggest to you detailed methods of applying the principles of Scientific Management in the Filene plant. I do not know enough. In the first place, I have not had the opportunity for more than casual inspection of the Filene store. I do not know exactly what you are doing, although I know the general principles governing your business operations. In the second place, Scientific Management has not been applied in any retail merchandising houses, and therefore I cannot suggest to you something based upon my observations of Scientific Management worked out in other merchandising houses. In fact, you have already done more than any other merchandising house of which I know, in the application of Scientific Management methods, and with that start you have before you the opportunity for the most complete application of the principles. When you have done that, and have informed me concerning what you have done, then I shall be able to stand before the personnel of some other merchandising house and tell them what they may do to apply the principles of Scientific Management in their business. All I have attempted to do is to bring to you some ideas concerning Scientific Management as I have seen it in that type of industry in which it has been applied—manufacturing—in the hope that you will be completely seized by its spirit and will work out the application of Scientific Management in distribution.

I have only three specific suggestion to make.

1. Scientific Management starts with, and is dependent upon, investigation. Make your investigating department one of the big departments of the store. It should not be merely a subsidiary department. It should be co-ordinate with, and co-operating with, all the other major departments of your business. If improvement depends upon an exact knowledge of facts, and an exact knowledge of facts can come only through persistent and careful investigation, then the department which is responsible for that persistent and careful investigation is logically a major department.

2. When the investigating department has decided that any particular way of doing a thing is worthy of honest trial, enter into the trial with your whole heart. That means, of course, that in your mind the presumption must be in favor of its being a good method, and you must observe carefully all directions given by the investigating department governing the manner in which the suggested method should be carried out.

3. After your co-operation with the investigating department has demonstrated that the new way of doing the thing is the best way, accept it as the new and standard method, and do not vary from this method thereafter until a better one has been discovered and proved to be better. And you must not be unwilling to co-operate in establishing that which I have alluded to during this hour by the use of the word "control." When a new best way of doing something has been devised, it will be found that that best way involves the assignment to each of several individuals the authority to order something to be done, or the responsibility to do something which has been ordered done. It is no violation of personal liberty to feel a self-imposed compulsion to do something which one is directed to do, if by some

co-operative arrangement in advance it has been agreed that one will do that thing when directed, under the particular defined circumstances. Nor on the other hand is it an increase of personal liberty or an arrogation of privilege to be in a position to direct that something be done by someone else, provided it has been agreed in advance that those to whom one has given the authority to direct shall do so under certain defined circumstances. In fact the very essence of co-operative organization and operation is that by mutual agreement each shall have the authority and the responsibility of directing something to be done, and each shall have the responsibility and privilege of doing something which someone has directed to be done. That is what is meant by organization, and what I have meant by control. Industry cannot exist without it, and the more perfectly control is worked out, the more productive industry will be, the greater the income of industrial efforts, and the greater the reward to everyone concerned. But the organization for the purpose of control may be, and should be, co-operative in its nature and not arbitrary.

DISCUSSION

Q. You said you thought Scientific Management gives a greater opportunity for self-expression. I wonder how, in a standardized job, a person has more opportunity for self-expression.

A. We erroneously think of the non-standardized job as giving opportunity for self-expression; the standardized job as removing the opportunity. However, the facts are just the reverse because of the different conditions under which the workman learns the job. The workman who does a thing in a non-standardized way has had to learn how to do it by observing an older workman. He has learned by imitation, which means without much inquiry why. He practices what he has learned as a matter of habit without inquiring why. The more the method can become reflex, without an idea of how and why, the more skilled he is. Now that man is not expressing himself; he is expressing a tradition passed on to him by the workman whom he is imitating. And there is nothing to inspire him to work out a better way.

The workman who is doing a standardized job, however, is doing it because he has been taught to do it. The teaching has involved why as well as how. It has involved comparison. It has stimulated observation and inquiry. As a result the man on the standardized job finds more incentive to, and opportunity for, self-expression than the man on the other job. In a certain shop the foreman pointed out to me a workman and said, "That man has been here in this plant twenty-four years, and has never until now made a suggestion. He has made sixteen this year, and received sixteen dollars reward; all the result of doing his old job according to the new way. In being taught the new way, he has been set to thinking."